



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/006,578	12/06/2001	Manoj K. Jain	TI-31858	4968

23494 7590 01/02/2003

TEXAS INSTRUMENTS INCORPORATED
P O BOX 655474, M/S 3999
DALLAS, TX 75265

EXAMINER

LE, THAO X

ART UNIT	PAPER NUMBER
----------	--------------

2814

DATE MAILED: 01/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/006,578

Applicant(s)

JAIN, MANOJ K.

Examiner

Thao X Le

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 October 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 3-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Acknowledgement

1. Applicant's cancellation of claims 2 in Paper No. 8 is acknowledged.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 3, 5-6 are rejected under 35 U.S.C. 102(b) as being anticipated by US Patent 5,494,860 to McDevitt et al.

Regarding to claim 1, McDevitt discloses a method of forming a conductive structure in an integrated circuit in Fig. 1, comprising the steps of: forming a dielectric layer 10, column 3 line 52, over a semiconductor body 1, column 3 line 42, forming a hole 16, column 3 line 53, in dielectric layer, forming a conductive liner 12, column 3 line 56, in hole, annealing conductive liner, column 7 line 4, treating conductive liner with hydrogen, column 7 line 6, forming a conductive barrier (titanium nitride), column 7 line 11, after treating the conductive liner with hydrogen, filling hole with a conductive material 14, column 3 line 56.

Regarding to claim 3, McDevitt discloses a method of forming a conductive structure wherein treating step occurs after step of forming a hole and before filling step, and annealing and treating steps are performed simultaneously, column 3 lines 22-27, column 4 line.

Art Unit: 2814

Regarding to claims 5, 6, McDevitt discloses wherein hydrogen containing atmosphere comprises pure hydrogen and hydrogen mixed with carrier gas, column 5 line 22.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 4, 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,494,860 to McDevitt et al in view of US Patent 6335282 to Sharan et al

Regarding to claims 4, 7, McDevitt do not expressly discloses a method of forming a conductive structure wherein treating step comprises a plasma treatment in a hydrogen-containing atmosphere comprises ammonia.

However, Sharan reference discloses a method of forming a conductive structure wherein treating step comprises a plasma treatment in a hydrogen containing atmosphere comprises ammonia, column 4 line 40 and 47. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to combine the teaching of Sharan with McDevitt, because it hydrogen containing plasma to form titanium nitride is well known in the art.

Regarding to claim 8, McDevitt and Sharan do not expressly discloses a method of forming a conductive structure further comprising the step of repeating treating step prior to filling step.

However, as discussed in claims 4 and 7 hydrogen plasma containing ammonia to form titanium nitride (TiN) is well known in the art. Repeating this hydrogen plasma treatment process is to form a desired thickness of TiN, Accordingly, it would have been obvious to use teaching of Sharan in the repeating step as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

6. Claims 9-11, 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,494,860 to McDevitt et al in view of US Patent 6,291,340 to Sandhu et al

Regarding to claim 9, McDevitt discloses as a method for forming a contact in an integrated circuit in fig. 1, comprising the step of: forming a dielectric layer 10, column 3 line 52, over a semiconductor body 1, column 3 line 42, etching a contact hole 16, column 3 line 53, extending through dielectric layer, depositing titanium 12, column 7 line 2, over dielectric layer 10, including on exposed surface with contact hole, annealing titanium, column 7 line 4, treating titanium with hydrogen, column 7 line 6, depositing titanium nitride, column 7 line 11, over titanium, and then filling contact hole with a conductive material 14, column 3 line 56.

But McDevitt does not disclose filling the contact hole with tungsten. However, Sandhu reference discloses filling the contact hole with tungsten. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to combine the teaching of Sandhu with McDevitt, because tungsten is well known and commonly used for such application as taught by Sandhu, column 7 line 33.

Regarding to claim 10-11, McDevitt discloses a method of forming a conductive structure wherein treating step occurs after step of forming a hole and before filling step, and annealing and treating steps are performed simultaneously, column 3 lines 22-27, column 4 line.

Regarding to claim 13, 14, McDevitt discloses wherein hydrogen containing atmosphere comprises pure hydrogen and hydrogen mixed with carrier gas, column 5 line 22.

7. Claims 12, 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,494,860 to McDevitt et al and US Patent 6,291,340 to Sandhu et al as applied to claim 9 above and further in view of US Patent 6335282 to Sharan et al

Regarding to claims 12, 15, McDevitt do not expressly discloses a method of forming a conductive structure wherein treating step comprises a plasma treatment in a hydrogen-containing atmosphere comprises ammonia.

However, Sharan reference discloses a method of forming a conductive structure wherein treating step comprises a plasma treatment in a hydrogen-containing atmosphere comprises ammonia, column 4 line 40 and 47. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to combine the teaching of Sharan with McDevitt, because it hydrogen containing plasma comprises ammonia to form titanium nitride is well known in the art.

Regarding to claim 16, McDevitt and Sharan do not expressly discloses a method of forming a conductive structure further comprising the step of repeating treating step prior to filling step.

However, as discussed in claims 12 and 15 hydrogen plasma containing ammonia to form titanium nitride (TiN) is well known in the art. Repeating this hydrogen plasma

Art Unit: 2814

treatment process is to form a desired thickness of TiN, Accordingly, it would have been obvious to use teaching of Sharan in the repeating step as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Response to Arguments

8. Applicant's arguments filed 10/31/02 have been fully considered but they are not persuasive. The applicant argues that the prior art (McDevitt) does not disclose forming a conductive liner in a hole of a dielectric layer, treating the conductive liner with hydrogen, and after treating the conductive liner with hydrogen, filling the hole with conductive metal. This is not persuasive because the prior art clearly discloses in fig. 1 forming a conductive liner 12 in a hole 16 of a dielectric layer 10, treating the conductive liner with hydrogen, column 7 line 6, and after treating the conductive liner with hydrogen, filling the hole with conductive metal 14.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X Le whose telephone number is 703-306-0208. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M Fahmy can be reached on 703-308-4918. The fax phone numbers for the

Art Unit: 2814

organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Thao X. Le
December 27, 2002



PHAT X. CAO
PRIMARY EXAMINER